



ASHRAE 2026 Design Competition

Project Description

- The annual Student Design Competition is a competition which challenges students to apply their knowledge of HVAC&R systems to a real-world design scenario
- The competition consists of three categories:
 - HVAC Design Calculations, which focuses on detailed load calculations, ventilation, and system sizing
 - HVAC System Selection, which emphasizes evaluating and justifying system choices based on life-cycle cost and sustainability
 - Setty Family Foundation Net Zero Energy Design, which requires a multidisciplinary approach to designing sustainable, energy-efficient buildings that meet or approach net zero energy standards
- This year the student design competition is centered around designing a new university building in Denver Colorado, with requirements that reflect real owner goals that include a list of restrictions

Theory

Heat Balance

$$Q_{total} = Q_{ext} + Q_{int} + Q_{vent}$$

Envelope Heat Gain/Loss

$$Q_{transmission} = U \times A \times \Delta T$$

Solar Heat Gain

$$Q_{solar} = A_{glass} \times SHGF \times SC \times CLF$$

Infiltration and Ventilation Load

$$Q_{inf} = 1.08 \times CFM \times \Delta T$$

$$Q_{vent} = 1.08 \times CFMOA \times \Delta T \text{ (sensible)}$$

Internal Loads

$$Q_{people} = N \times (Sensible + Latent)$$

$$Q_{lights} = W_{lights} \times 3.41 \times CLF$$

Standards Description

ASHRAE 55 (Thermal Environmental Conditions for Human Occupancy)

- Establishes acceptable ranges for temperature, humidity, air speed, and radiant heat to ensure at least 80% of occupants find the indoor environment comfortable

ASHRAE 62.1 (Ventilation and Acceptable Indoor Air Quality)

- Sets minimum ventilation requirements

ASHRAE 90.1 (Energy Standard for Sites and Buildings Except Low Rise Residential Buildings)

- Sets the baseline for energy-efficient design of buildings, including HVAC systems, lighting, building envelope, and water heating systems

Background

- ASHRAE stands for the American Society of Heating, Refrigerating and Air-Conditioning Engineers
- It is an international nonprofit organization with over 50,000 members in more than 130 countries
- Founded in 1894, its mission is to advance human well-being through sustainable technology for the built environment
- ASHRAE plays a leading role in shaping modern building systems, energy use, indoor air quality, refrigeration, and sustainability practices worldwide

Owners Project Requirements

Summary: Safe, sustainable, energy-efficient design, with emphasis on occupant health, safety, and comfort. Building will be designed for flexibility of future modifications, maintainability, and long-term cost effectiveness.

Building Information

Location: Denver, Colorado

Building Type: University classrooms, lab, culinary

Size: 93,000sqft, two floors, mechanical systems penthouse

Economic And Life Cycle Cost

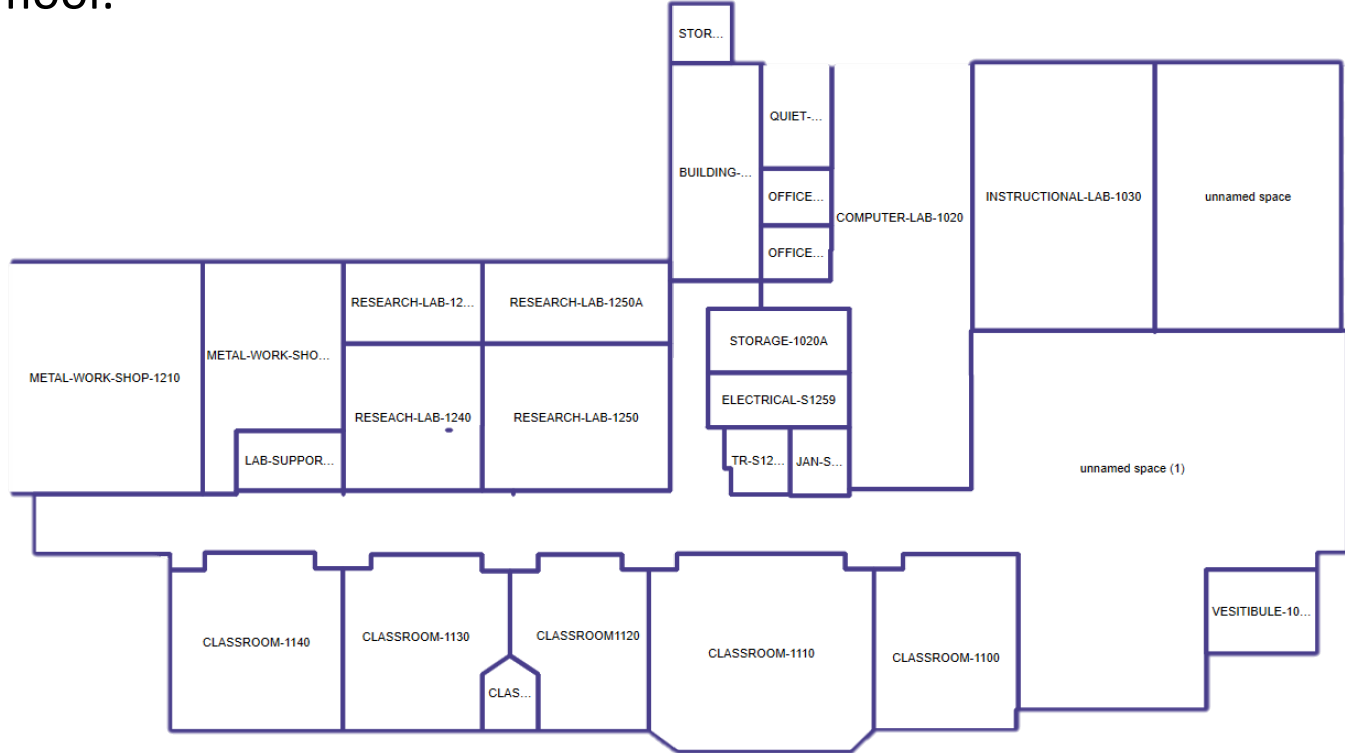
Rates to calculate the total cost of owning, operating, and maintaining a system over its entire service life, including initial, energy, maintenance, and replacement costs.

- Electricity: \$0.145kWh (7am-11pm), \$0.10/kWh (11pm-7am)
- Natural Gas: \$0.80/therm, Annual escalation: 3%
- Economic Parameters: Inflation rate: 3%, Owner’s rate of return: 4%

Carrier Hourly Analysis Program

HAP calculates the hourly cost of a building by simulating heat balance equations for net envelope heat gain, solar heat gain, internal loads, and infiltration and ventilation load for each room.

The program does this by using a 3D model of the building, which is made by an engineer using HAP. The model is developed by importing the floor plans and outlining them in the software. The outline is then extruded for each floor.



System Selection

System	Energy	Zoning	IAQ	Maintenance	Scale	First Time Cost	Maintenance Cost	Sum
https://flic.kr/s/aHBqjCx4Qd								
Central Chiller+ hot water boiler + VAV	3	2	2	2	3	2	2	16
Central Chiller + condensing boiler + DOAS + FCUs	3	3	3	1	3	1	1	15
WSHP loop with central heat rejection	2	3	1	2	2	3	1	14
VRF with DOAS	3	3	3	2	2	2	2	17
GSHP with central distribution	3	2	2	2	2	1	2	14

Semester Deliverables

Design Calculations Requirements

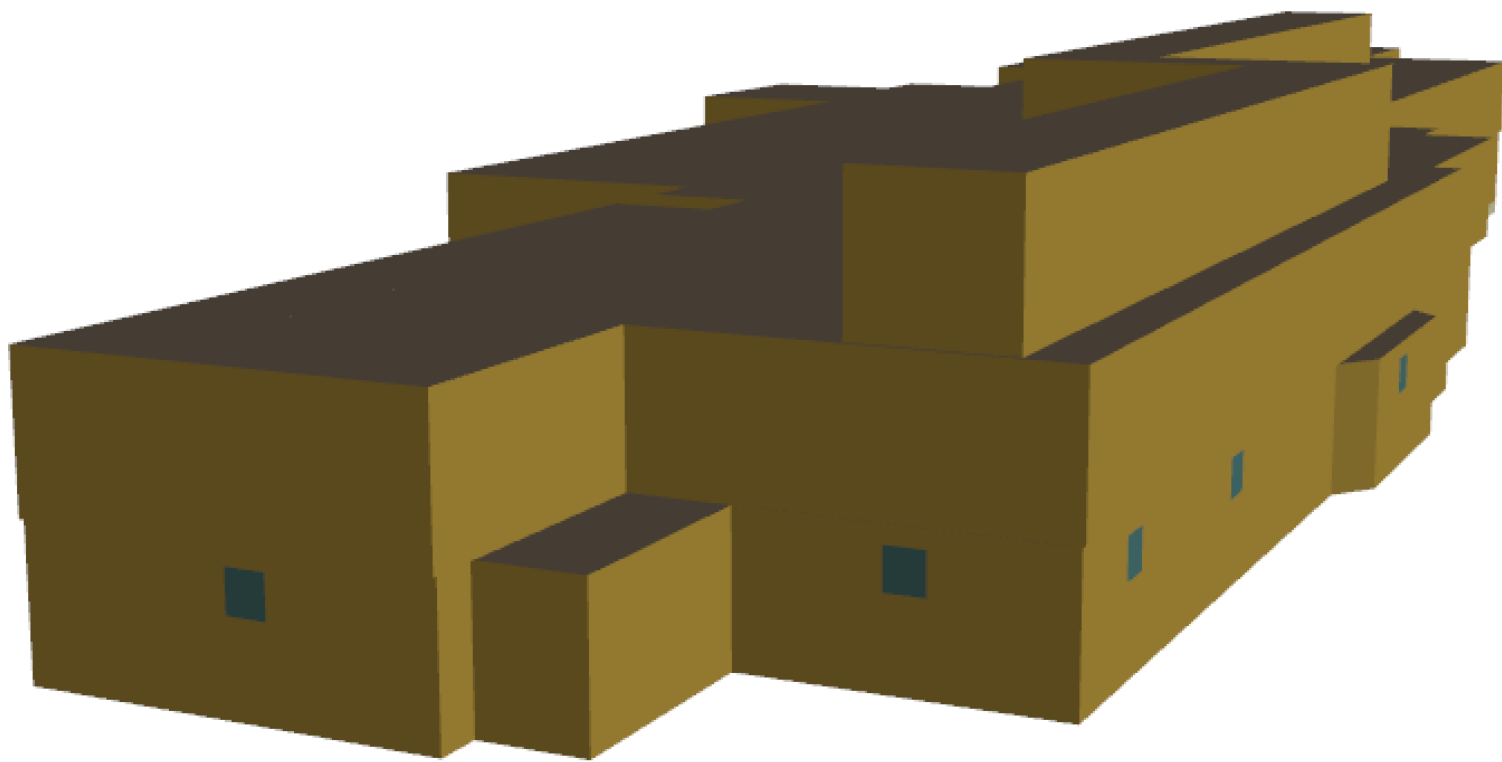
- Schedules for all major equipment components selected, including listed equipment efficiencies
- Mechanical floor plans showing equipment layout and single line duct size and layouts, piping sizes and layouts, terminal units, diffusers, grilles, registers, thermostats, humidistats etc.
- Detailed example(s) of design detail in compliance with ASHRAE references.
- Schematic flow diagram indicating components and accessories, piping sizes
- Heating and Cooling Load Calculations: Provide checksum reports for each system, design cooling and heating block load reports for selection of cooling and heating plants

System Selection Requirements

- Compare and rank (3) unique HVAC Systems and demonstrate how they meet needs of the owner through multiple examples
- Discussions such as life cycle cost, environment impact for all three systems and must include multiple examples.
- 15 minute presentation to sell design to owner

Setty Family Foundation Net Zero Energy Design

- Develop ECMS (Solar hot water, heat recovery, LED lighting) with quantitative analysis of each
- Renewable Energy Integration, show how the design can decrease at least 5% of peak electrical load
- Sustainability and Operation Plan , a program for building operation which ensures long term performance and maintenance, through construction, commissioning, and operation



Faculty Mentor: Dr. Lin



Jasmine Lin



Zach MacDonald



Darren Prashad



Michael Spellman Jr.